

Impact of Climate Change on Photochemical Air Pollution in Southern California



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Introduction

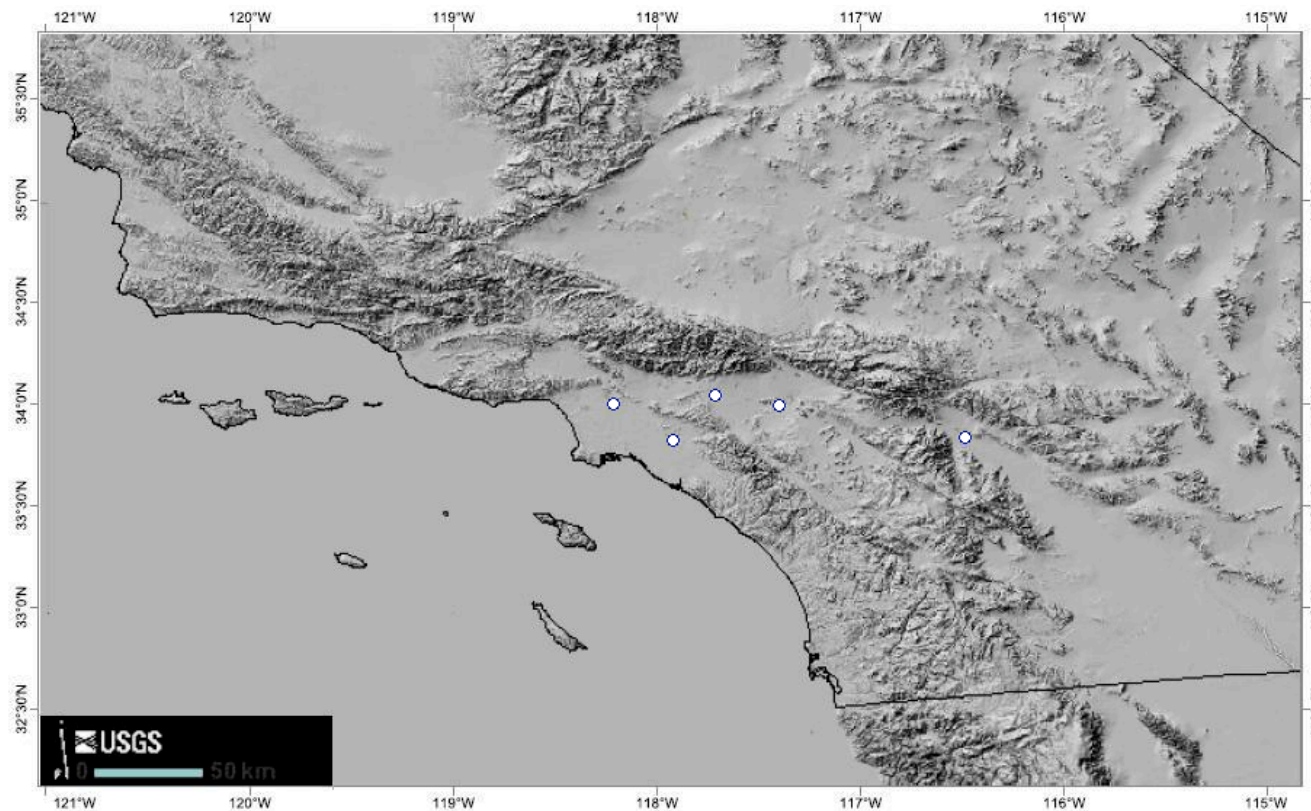
- California has serious air pollution problems:
 - Tropospheric ozone (“smog”)
 - Airborne particulate matter
- Further emission controls needed to achieve acceptable air quality
- Climate change may add to the burden of emission controls needed in the future

Study Design

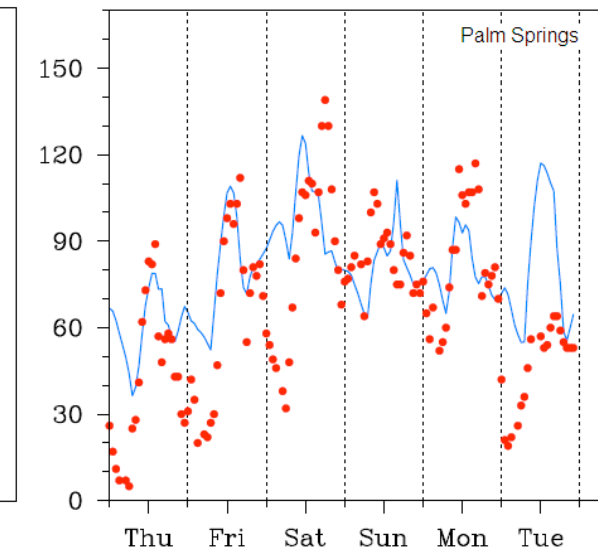
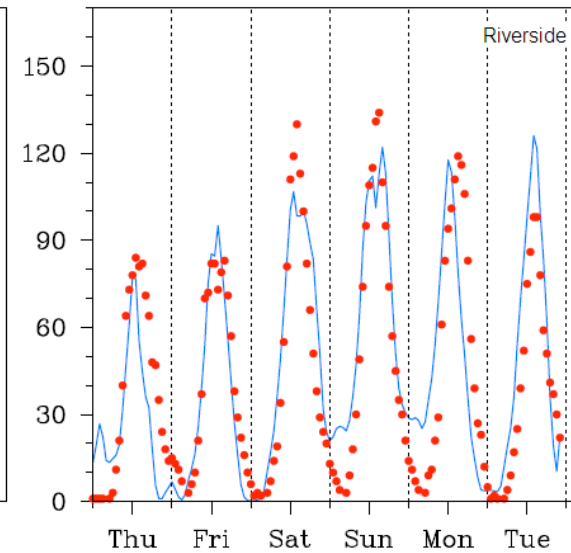
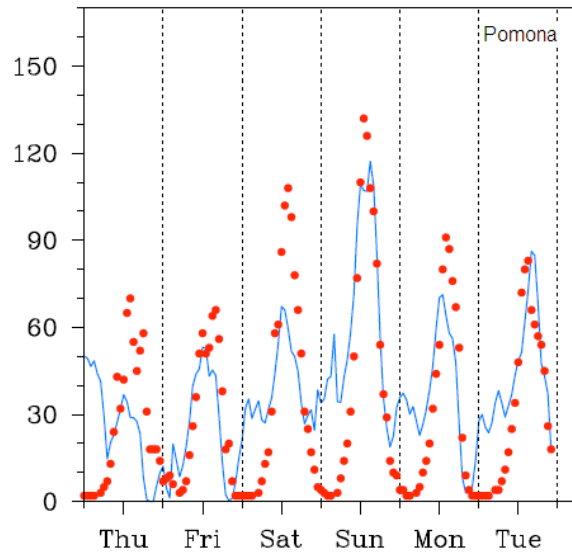
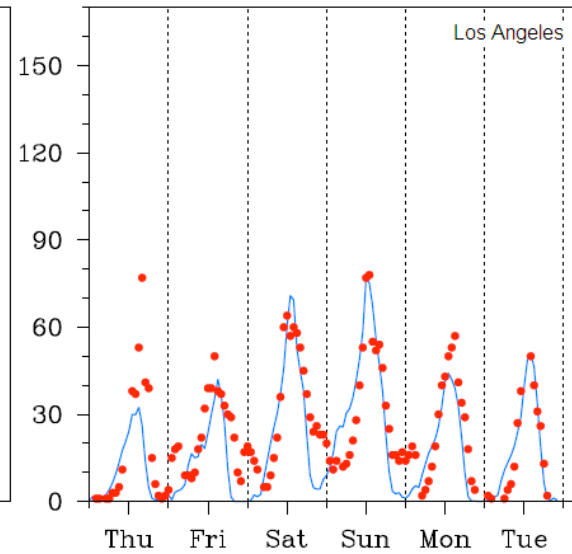
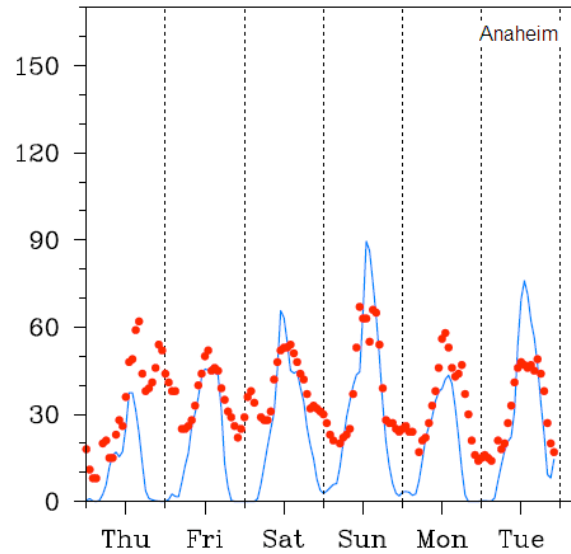
- Model air quality in Southern California
 - Base case high-ozone episode
 - Future changes:
 - 2× pre-industrial CO₂
 - Increased pollutant inflow from Pacific Ocean
 - 2050 future SoCal emissions scenario
 - Combination of all of the above
- Follows Steiner et al. (JGR 2006) study of effects on ozone in Central California

Air Quality Model

- 3-D Eulerian air quality model (CMAQ V4.6)
- 14-19 July 2005 ozone episode in So. Cal.
- MM5 met fields from South Coast AQMD
- Gridded emission inventory from Air Resources Board

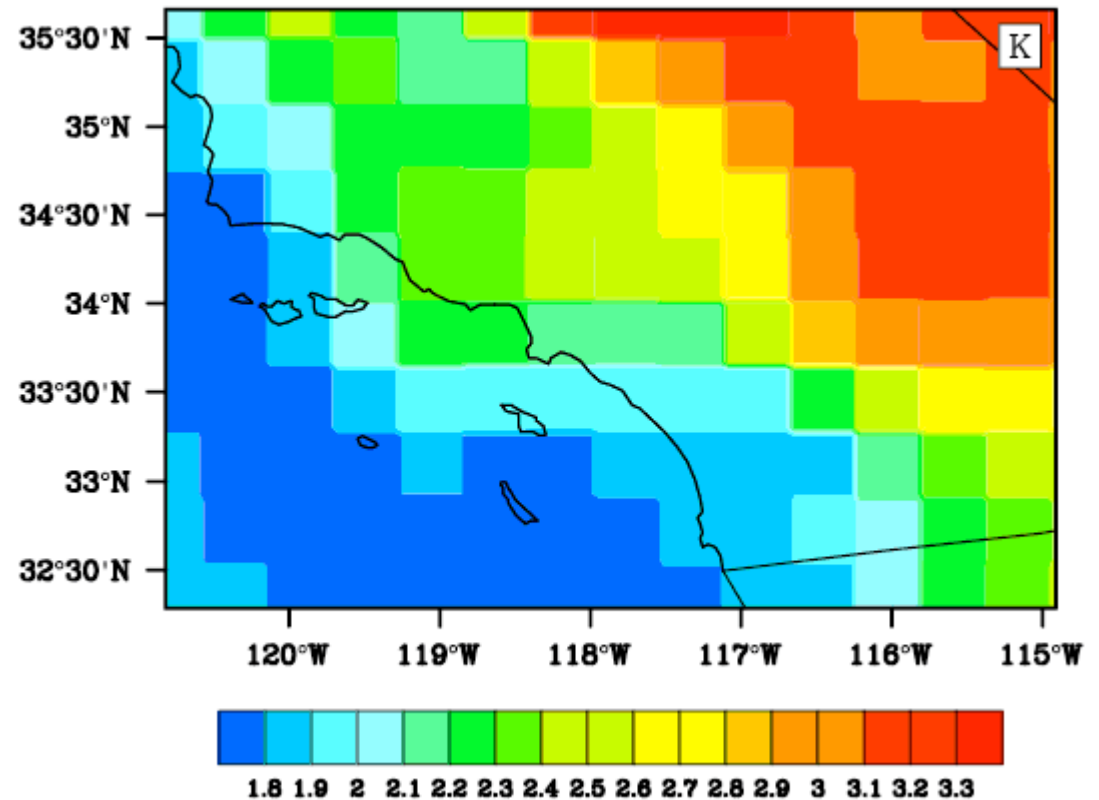


Predicted & Observed O₃ (ppb)



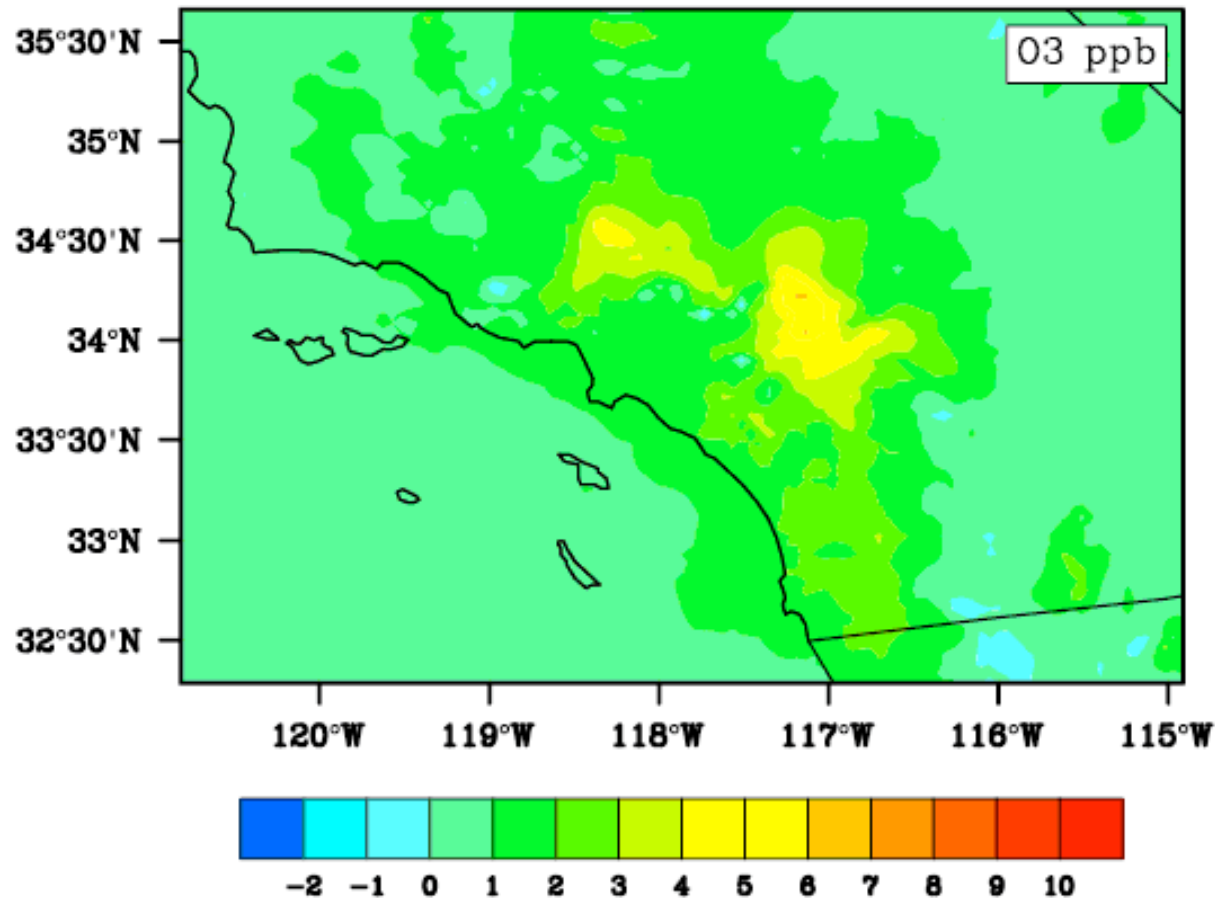
Climate Change

- Regional climate model for California at 40 km resolution (Snyder et al., 2002)
- Driven by global model with 2× pre-industrial CO₂



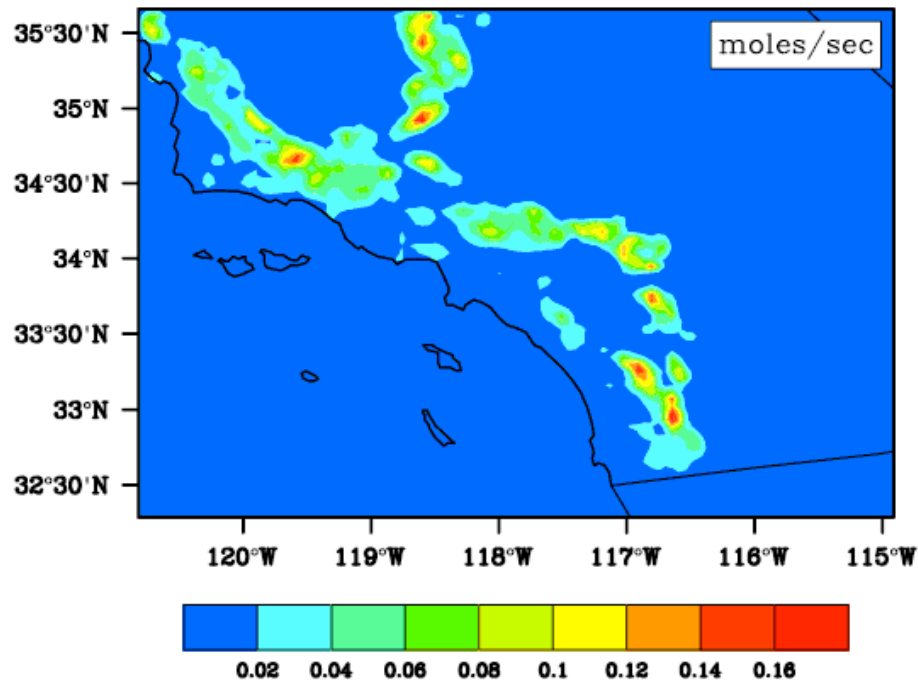
July Temperature Increase (°C)

Higher T \Rightarrow Faster Atmospheric Reaction Rates

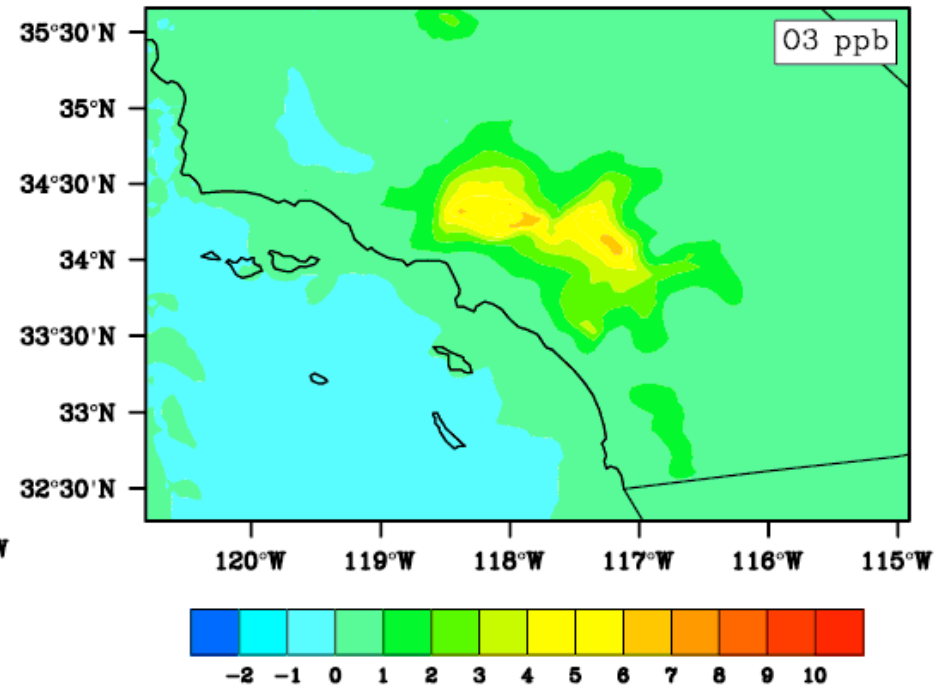


Ozone Increase (ppb) due to higher T

Higher T \Rightarrow Increased Biogenic VOC Emissions

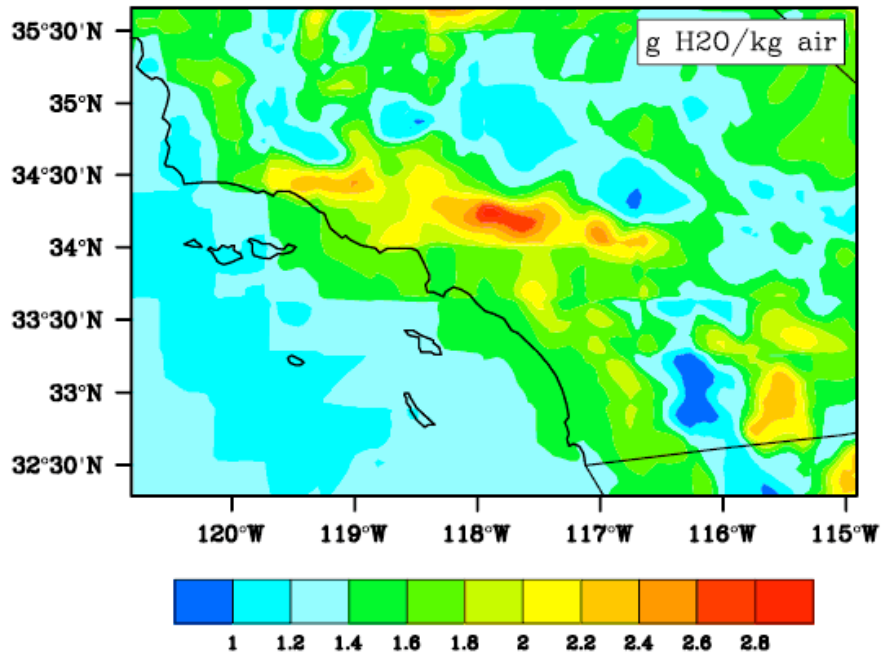


BVOC Emissions
Increase (mol/s)

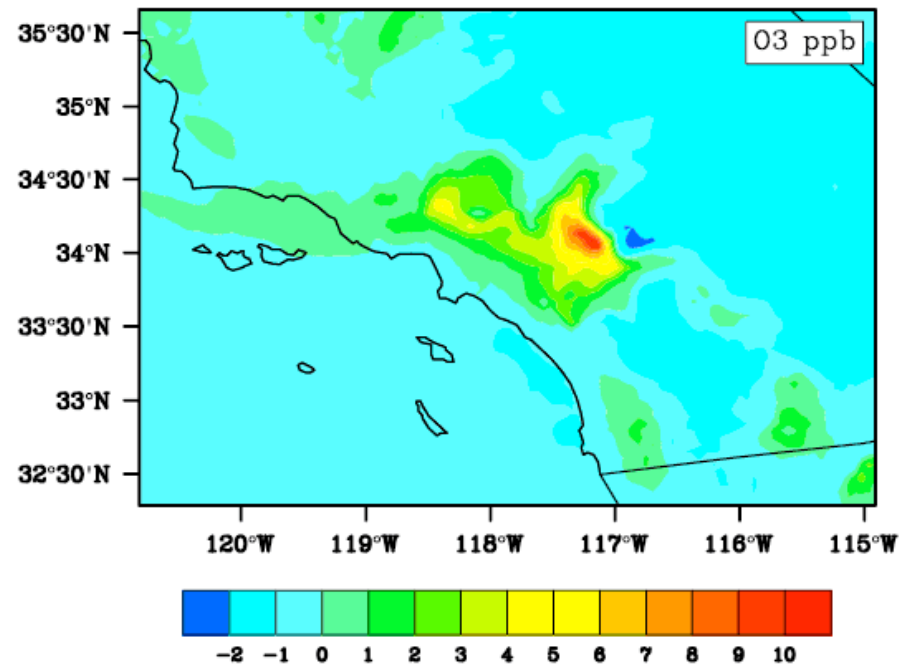


Ozone Increase (ppb)

Effect of Increased Humidity

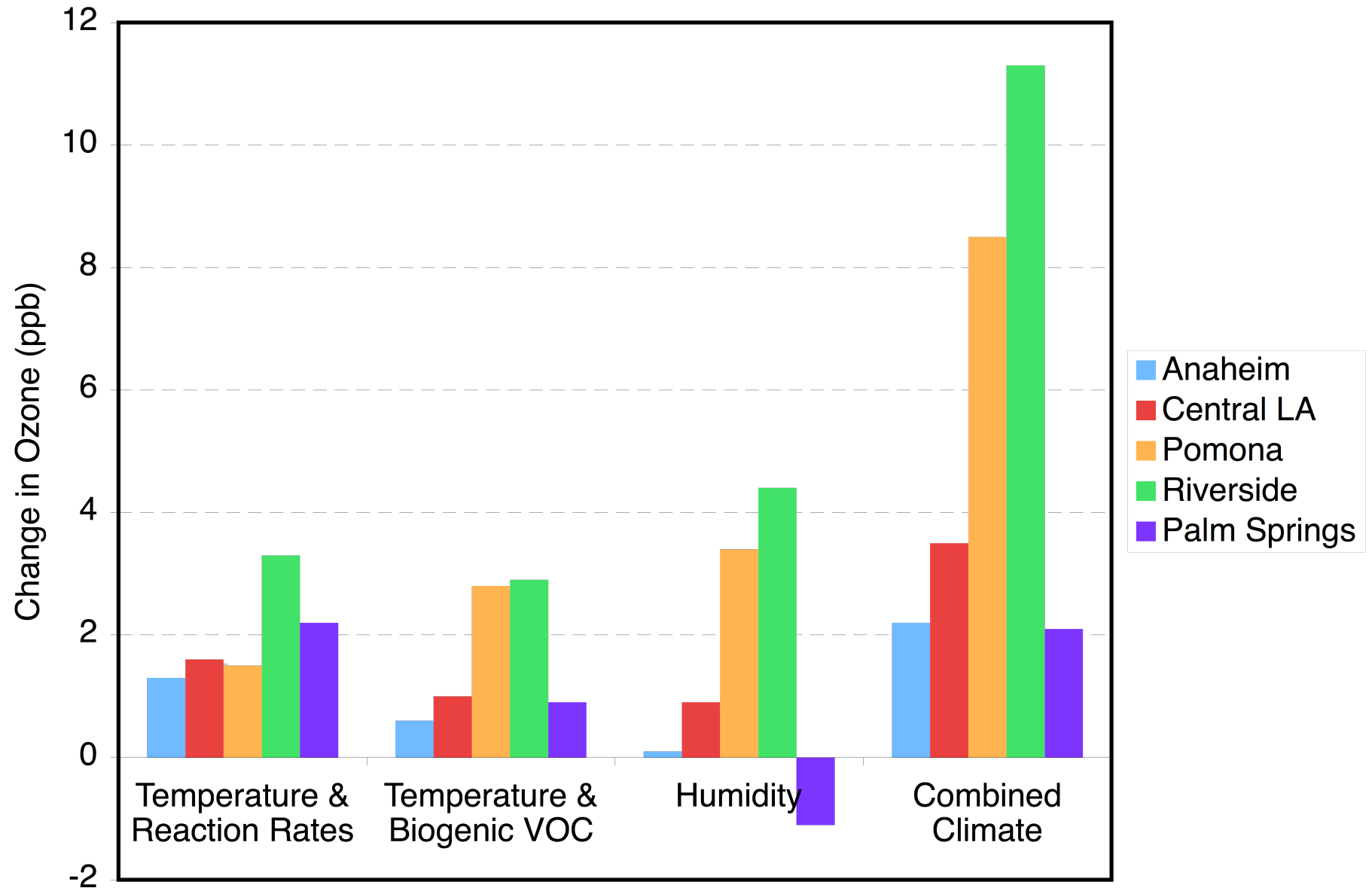


Increase in Water Vapor



Ozone Increase (ppb)

Summary of Climate Effects



Other Issues to Consider

- Changes in frequency of high-ozone episodes
- Climate change effects on vegetation
 - Forest fires
 - Changes in land cover/vegetation type
- Climate change effects on particulate matter
- Health & other effects of changes in air quality

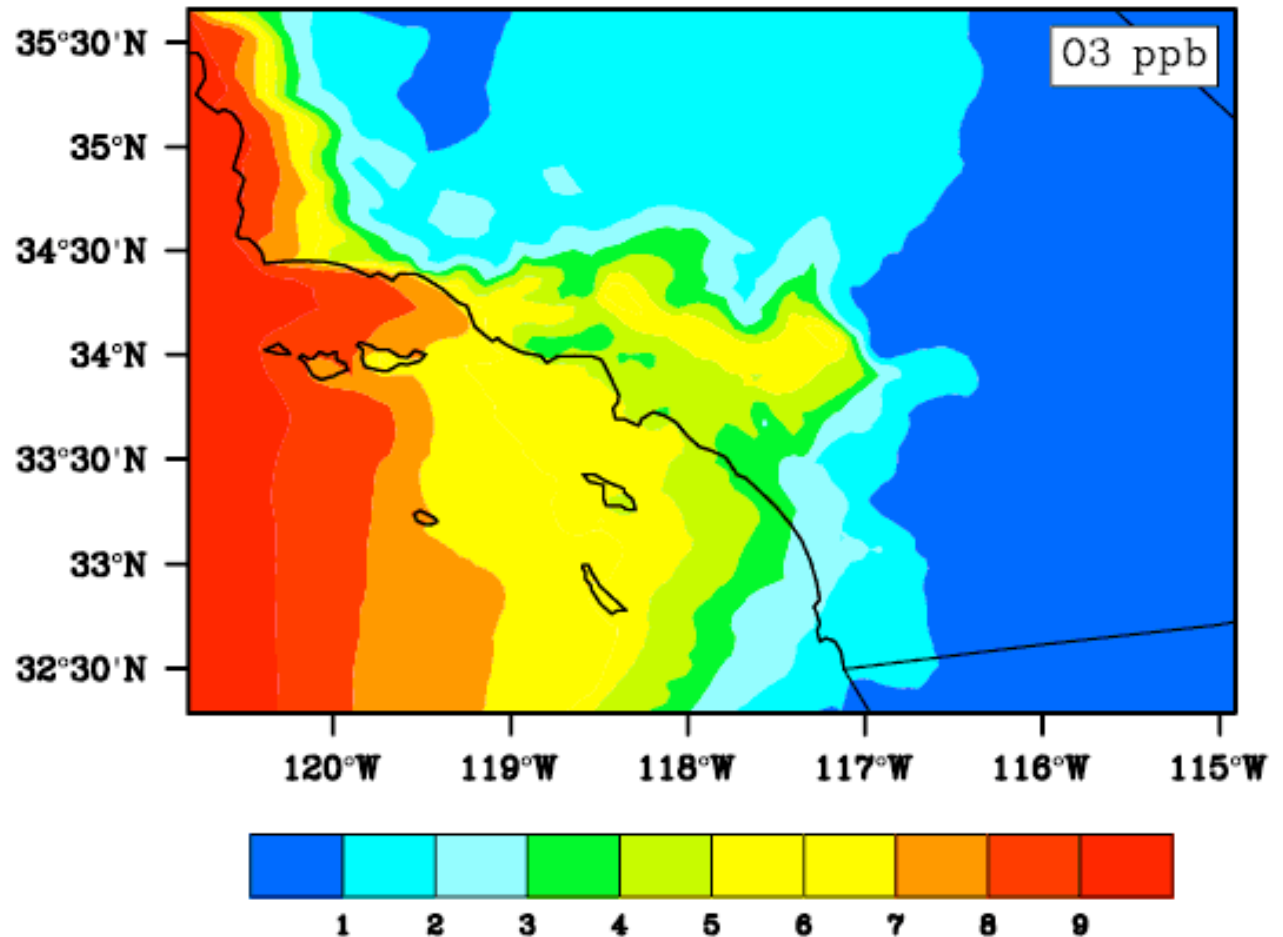
Effect of Increased Pollutant Inflow from Pacific Ocean

Western Boundary
Conditions
Increased:

CO: 80 to 104 ppb

CH₄: 1.7 to 2.4 ppm

O₃: 30 to 40 ppb

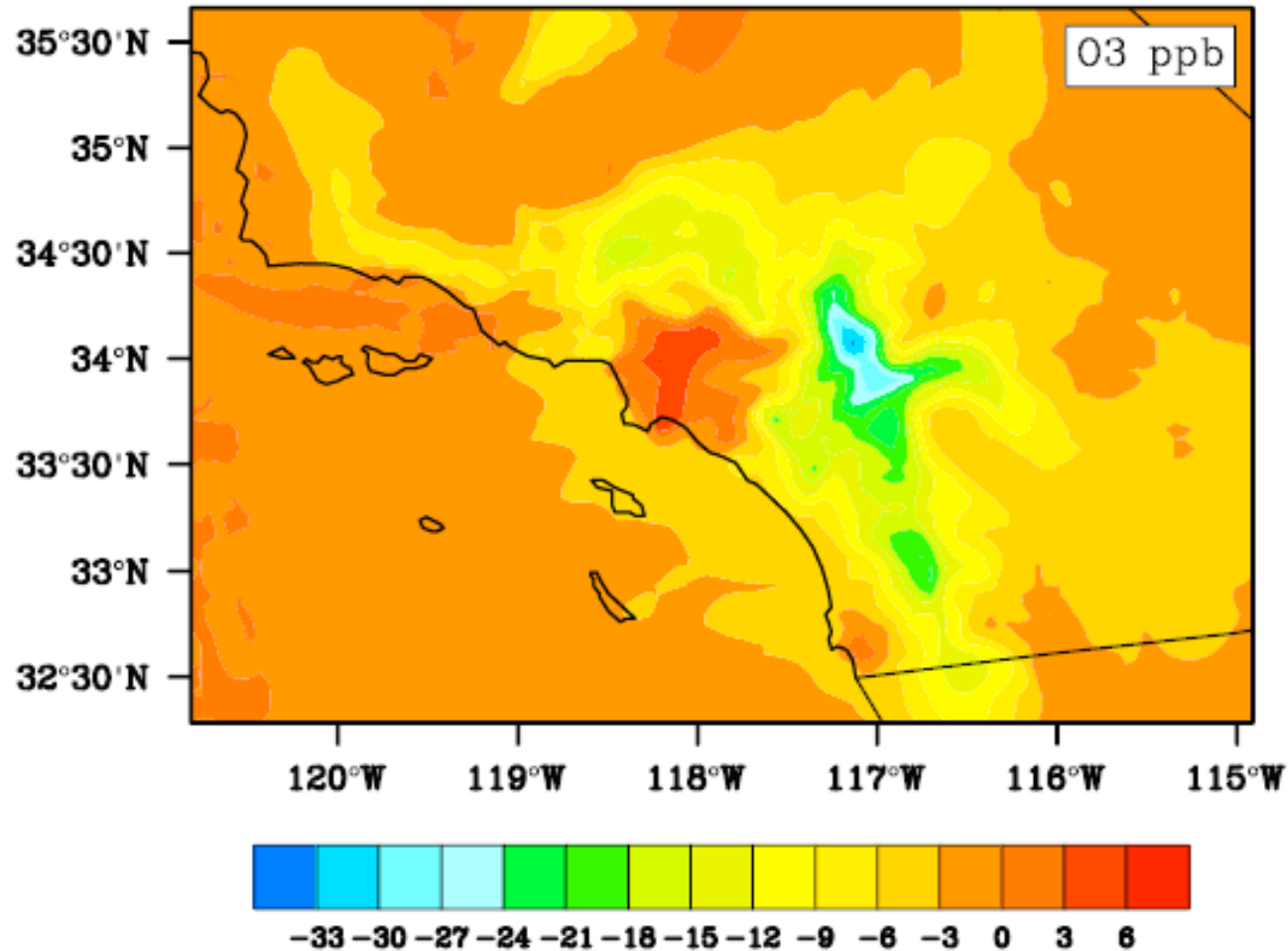


Ozone Increase (ppb)

Southern California: Future Emissions as of 2050

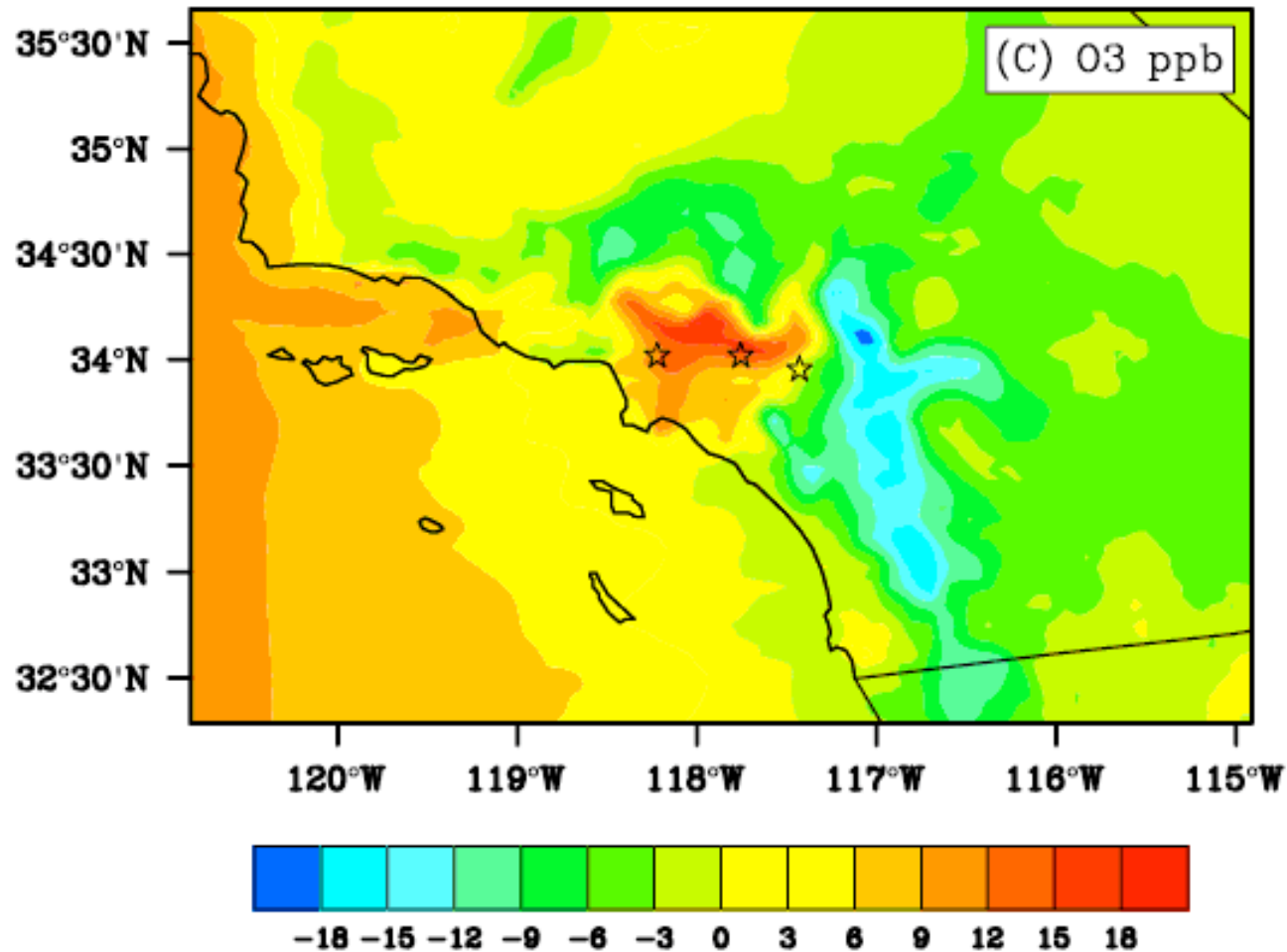
- Population growth by county from California Dept. of Finance demographic forecasts
- Assumed faster growth rate in diesel truck traffic vs. other sources
- 80% reduction in all emission factors below base case (2005) values
- Does not include AB32 or other mandates to reduce greenhouse gas emissions

Ozone with 2050 SoCal Emissions



Change in Ozone (ppb) vs. base case

Combined Climate, Inflow BC & 2050 SoCal Emissions



Ozone Change (ppb)

Summary of Ozone Effects

